



The smoking habit of a best friend or family member – how deep is the impact? A cohort study

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The smoking habit of a best friend or family member –
how deep is the impact? A cohort study

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Keywords: Tobacco, Smoking, Family influence, Social influence

Word count: 2,497

ABSTRACT

Objectives: To quantify the risk of becoming a smoker in adulthood associated with parental smoking as well as the smoking of siblings and best friends.

Design: Prospective and retrospective cohort study.

Setting: Four oral health care centres in Finland and a follow-up.

Participants: An age cohort born in 1979 (n=2,586) and living in four Finnish towns. Of those reached by the 2008 follow-up, 46.9% (n=1,020) responded.

Primary and secondary outcome measures: Smoking behavior at the age of 29.

Smoking behavior at the age of 13 and smoking behaviour of family members and best friends.

Results: Smoking of a best friend in current life was strongly associated with subjects' own smoking (OR 5.6, 95% CI 3.6–8.8). The smoking of a best friend during schooldays was similarly associated (OR 2.9, 95% CI 1.8–4.5). Smoking among males was associated with the smoking behavior of mothers and siblings while that of females was not. Those smokers whose parents smoked when they were at school were heavier smokers in adulthood.

Conclusions: The impact of a smoker as a best friend is greater than that of a smoking parent or sibling in school age when it comes to smoking behavior in adulthood. This should be taken into consideration when attempting to prevent smoking initiation or continuation.

Trial registration: At clinicaltrials.gov (NCT01348646).

ARTICLE SUMMARY

Article Focus

- When considering the gravity of social influences in smoking behavior, which are more important – family members or best friends?

Key Messages

- If one’s best friend in adulthood smokes, one is also likely to smoke
- The second most important social influence for smoking comes from the best friend on schooldays (at 13 years)
- Smoking family members have an impact on the smoking behavior of males, but not on females

Strengths and Limitations

All the studies social influences on smoking were studied from the same population. A limitation is that the smoking behavior of best friend and siblings on schooldays were measured retrospectively.

INTRODUCTION

Smoking is an unhealthy and lethal habit. There is a linear association between the duration and heaviness of smoking and its negative impact on an individual's health. A persistent smoking habit greatly increases the risk of premature death [1]. If smoking disappeared from this world, millions of lives would be saved [2].

The development of nicotine dependence and smoking habit is linked to social influence from family and friends [3–6]. Children who are exposed to smoking behavior at home are more likely to experiment with smoking [7, 8]. A smoking parent makes an adolescent more positively disposed to smoking. [9]. Smoking siblings also increase the risk of regular smoking [10]. Adolescent cessation programs including a parental approach have reported good results [11]. This emphasizes the importance of family influences in adolescent smoking.

The smoking behavior of friends has a great influence on adolescents' own smoking habits [12]. The influence of smoking friends seems to be greater than that of smoking parents when considering the likeliness of an adolescent to start smoking [13–15] or continuing the habit from adolescence to adulthood [16].

There is also evidence that the increased risk of continuing smoking caused by a smoking friend is comparable to that caused by smoking parents [17]. A male best friend who smokes seems to have a greater effect on smoking initiation than a female best friend who smokes [18]. Genes seem to influence the choice of friends and thus indirectly influence adolescent smoking [19].

There are a variety of theories regarding the association of social influence and smoking behavior. Perceived influence theories try to explain this through adolescents' perceptions of their peers' smoking behavior. In external influence theories the smoking behavior of peers has a direct influence on adolescent smoking. Group level theories examine how differences in gender, race and subculture influence the relationships and thus smoking behavior. [20]

Approximately one in four adult males and one in five adult females in Finland are regular smokers [21]. In Finland the smoking trends have been slightly diminishing in recent years. Nevertheless, the smoking rate among young adult females remains a significant issue and recent global evidence shows even worse smoking rates among females [22, 23].

During the period 1992–1994 a study was carried out in the Finnish regions of Southern and Central Ostrobothnia, in the towns of Vaasa, Pietarsaari, Kokkola and Seinäjoki [24]. These towns form a province with very homogenous school conditions. The cohort (n=2,582) responded to questions and a questionnaire during a school dental checkup. Their and their parents' smoking behavior and attitudes towards smoking were elicited. The smoking rate in this population was 5.7% (n=148) at the beginning of the study and 19.4% (n=304) during the final examination in 1994 [24].

The aim of this study was to ascertain the risk of becoming an adult smoker associated with parental smoking as well as the smoking of siblings and best friends.

MATERIALS AND METHODS

The cohort consisted of all subjects born in 1979 and living in 1992 in one of the previously mentioned four towns (Figure 1). Of the age cohort 99.1% participated in a dental checkup in 1992. During the checkup they responded to a questionnaire and some oral questions. Their current smoking behavior and their intentions to experiment with smoking were elicited. There were also questions about the smoking behavior of their parents and their parents' attitudes to adolescents' smoking.

A questionnaire was sent to the available cohort (n=2,175) in 2008 to addresses obtained from the Population Register Centre (Figure 1). The response rate was 46.9% (n=1,020). Respondents were classified as smokers and non-smokers according to their responses to the question "Do you smoke?" (No/Yes). Duration of smoking was calculated for ex-smokers by subtracting age at initiation from age at cessation. Duration of smoking was calculated for smokers by subtracting age at initiation from 29 (the average age of the cohort at the time of the questionnaire mailing). Amount of tobacco products consumed in numbers of cigarette was also elicited.

In the questionnaire the respondents were asked to look back at their smoking exposure in their schooldays. The respondents answering "yes" to the question "When you were of school age, did your father smoke?" (No/Yes/Can't say) were deemed to have had a smoking father in their schooldays. The same pattern was repeated with similar questions about the smoking habits of mother, brother, sister

1 and best friend during respondents' schooldays. The respondents answering "yes"
2
3 to the question "Does your best friend smoke?" were deemed to currently have a
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5 smoking best friend.
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10 We also measured some potential confounders for smoking. These were marital
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12 status, level of education and self-perceived health. Marital status was elicited
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14 (Single/Married/Cohabiting/Remarried/Divorced/Widowed). Single, divorced and
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16 widowed respondents were classified as single, while married, remarried and
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18 cohabiting respondents were classified as married or cohabiting in the analysis.
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20 Education was classified as higher education if the respondent had a polytechnic
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22 or university degree. All other education was classified as lower education.
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24 Respondents' self-perceived health was also elicited (Very
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26 good/Good/Average/Poor/Very poor/Can't say). The responses were reclassified
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28 as Very good/Not very good, where all answers other than Very good were
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30 classified as Not very good.
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37 In the envelopes there was also a cover letter describing the purpose and
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39 methodology of the study and a consent form. Only completed questionnaires
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41 returned with a signed consent form were used as data. The Ethics Committee of
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43 the Pirkanmaa Hospital District, Finland, approved the study protocol (R08017).
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48 In this study we combined two different settings. The first setting was a
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50 prospective follow-up, where we used the information from the 1992 checkups
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52 and checked if these attitudes at the age of 13 had an association with smoking
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54 behavior in 2008. The second setting was retrospective and cross-sectional. In this
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56 setting we used only the information from the 2008 questionnaire and checked for
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associations with the respondents' own smoking behavior and that of their own best friends (current and in school) and family members.

Statistical analysis

We used IBM SPSS version 20.0 to conduct the statistical analyses. Binary logistic regression was used with 95% confidence interval (CI). To compare the mean age at smoking initiation and mean duration of smoking (Gaussian distribution) we used the unpaired T-test. Two binary outcome measures were compared with χ^2 -test.

RESULTS

Of all respondents 16.9% (n=168) were smokers in 2008 (Table 1). Smoking rates were 14.4% (n=86) among females and 20.4% (n=82) among males (p<0.05). The majority of respondents was married or cohabiting, had higher education and perceived their health to be very good (Table 1).

Table 1: Comparison of the cohort characteristics in the 1992 study and in the 2008 follow-up.

| | 1992 initial study | | 2008 follow-up | |
|---------------|--------------------|------------|----------------|------------|
| | n | % of group | n | % of group |
| Gender | | | | |
| Female | 1,251 | 48.8 | 596 | 59.8 |

| | | | | |
|-----------------------|-------|------|-----|------|
| Male | 1,310 | 51.2 | 401 | 40.2 |
| Smoking behavior | | | | |
| Smoker | 145 | 5.7 | 168 | 16.9 |
| Non-smoker | 2,413 | 94.3 | 829 | 83.1 |
| Marital status | | | | |
| Single | - | - | 221 | 34.5 |
| Married or cohabiting | - | - | 775 | 65.5 |
| Education | | | | |
| Lower | - | - | 338 | 34.2 |
| Higher | - | - | 651 | 65.8 |
| Self-perceived health | | | | |
| Very good | - | - | 866 | 86.9 |
| Not very good | - | - | 130 | 13.1 |

The majority of smokers had lower education while only less than one third of non-smokers had lower education (Table 2). This difference was statistically significant. Smokers also differed statistically significantly from non-smokers with regard to their self-perceived health; more than one out of four smokers had not very good self-perceived health while only one of ten non-smokers had other than very good self-perceived health (Table 2). There were also statistically significantly more females among non-smokers (Table 2). Only 18.5% (n=31) of the smokers had started to smoke at the age of 18 or older.

Table 2: Comparison of smokers and non-smokers according to the measured potential confounders.

| | Smokers (n = 168) | | Non-smokers (n = 829) | | <i>p-value</i> |
|------------------------------|-------------------|------------|-----------------------|------------|------------------|
| | n | % of group | n | % of group | |
| Gender | | | | | 0.016 |
| Female | 86 | 51.2 | 510 | 61.5 | |
| Male | 82 | 48.8 | 319 | 38.5 | |
| Marital status | | | | | 0.155 |
| Single | 44 | 26.3 | 177 | 21.4 | |
| Married or cohabiting | 123 | 73.7 | 652 | 78.6 | |
| Education | | | | | <0.001 |
| Lower | 94 | 56.6 | 244 | 29.6 | |
| Higher | 72 | 43.4 | 579 | 70.4 | |
| Self-perceived health | | | | | <0.001 |
| Very good | 121 | 72.0 | 745 | 90.0 | |
| Not very good | 47 | 28.0 | 83 | 10.0 | |

Prospective setting

There were 24.1% (n=99) smokers in 2008 among those who reported having a smoking parent or smoking parents in the 1992 questionnaire, while only 11.7%

(n=68) of those with the opposite response smoked ($p<0.001$). Females did not differ statistically significantly from males according to the results on this question: OR for being smoker was 2.0 (1.3–3.3) for females and 2.6 (1.5–4.7) for males with smoking parent(s).

Of those respondents who at the age of 12 reported intending to experiment with smoking, 27.5% (n=11) were smokers in adulthood, while only 12.3% (n=80) of those who did not intend to experiment with smoking, were smokers in adulthood ($p=0.01$). If the experiment had been conducted when the respondents were aged 12, the impact on adult smoking rate would have been even greater: one in four adolescents who had experimented with smoking were smokers at the age of 29 while there were only 9.2% smokers among those who had not experimented in adolescence ($p<0.001$). Parental acceptance of adolescent smoking or the assumption of continuing smoking did not have a statistically significant impact on smoking in adulthood.

Cross-sectional setting

There was a strong connection with the smoking behavior of the current best friend. Among those who currently had a smoking best friend it was 5 times more likely that they, too, were smokers (Table 3). This connection was even stronger among males, but slightly weaker among females. Having a smoker as a best friend in school was connected with more than five times greater likelihood of being a smoker in adulthood in females, but not in males. Smoking of mother, brother or sister when the subject was of school age increased the likelihood of

being a smoker more than twofold among males, but not among females. The smoking behavior of father when the subject was of school age did not have a connection with smoking behavior in adulthood. (Table 3)

Table 3: Comparison of females, males (univariate) and all respondents (adjusted by gender, marital status, education and self-perceived health) according to their own smoking behavior and the smoking behavior of their family members and friends. OR = Odds Ratio, CI = Confidence Interval.

| | | Female | | Male | | All* | |
|------------------------|------------|----------------|--------|----------------|-----------------|---------------|-----------------|
| | | <i>p</i> - | | | | | |
| | | OR (95% CI) | value | OR (95% CI) | <i>p</i> -value | OR (95% CI) | <i>p</i> -value |
| Best friend | | | | | | | |
| <i>In current life</i> | | | <0.001 | | <0.001 | | <0.001 |
| | Non-smoker | 1 | | 1 | | 1 | |
| | Smoker | 4.7 (2.5-8.6) | | 7.1 (3.6-14.0) | | 5.0 (3.1-7.8) | |
| <i>In school</i> | | | <0.001 | | 0.2 | | <0.001 |
| | Non-smoker | 1 | | 1 | | 1 | |
| | Smoker | 5.1 (2.6-10.0) | | 1.6 (0.8-3.1) | | 3.1 (1.9-5.0) | |
| Mother** | | | 0.45 | | 0.04 | | 0.06 |
| | Non-smoker | 1 | | 1 | | 1 | |
| | Smoker | 1.3 (0.7-2.5) | | 2.3 (1.1-4.9) | | 1.7 (1.0-2.8) | |
| Father** | | | 0.61 | | 0.9 | | 0.7 |

| | | | | |
|----|-----------|------------|---------------|---------------|
| 1 | | | | |
| 2 | | Non-smoker | 1 | 1 |
| 3 | | | | 1 |
| 4 | | Smoker | 1.2 (0.6-2.2) | 1.1 (0.5-2.1) |
| 5 | | | | 1.1 (0.7-1.8) |
| 6 | | | | |
| 7 | Brother** | | 0.40 | 0.04 |
| 8 | | | | 0.9 |
| 9 | | Non-smoker | 1 | 1 |
| 10 | | | | 1 |
| 11 | | Smoker | 1.4 (0.7-3.0) | 2.1 (1.0-4.4) |
| 12 | | | | 1.6 (0.9-2.7) |
| 13 | | | | |
| 14 | | | | |
| 15 | Sister** | | 0.58 | 0.04 |
| 16 | | | | 0.8 |
| 17 | | Non-smoker | 1 | 1 |
| 18 | | | | 1 |
| 19 | | Smoker | 1.2 (0.6-2.6) | 2.6 (1.1-6.2) |
| 20 | | | | 1.7 (0.9-3.0) |

* Adjusted multivariate analysis

** When the respondent was in school age

In the adjusted model we combined all the family members and best friends (both current and in schooldays) with the measured confounders into a multivariate logistic regression. In this model self-perceived health and marital status had an independent connection with smoking behavior. The impact of friends (current or in schooldays) persisted while that of all the family members disappeared in the multivariate analysis (Table 3).

Differences were observed in the age of smoking initiation for the smokers and ex-smokers in the cohort. Smoking was initiated 0.8–1.7 years younger among those who had a smoking family member in their schooldays (Table 4). Initiation of smoking occurred almost three years earlier among those who had a smoking best friend at school and almost one year earlier among those currently having a smoker as a best friend. Mean duration of smoking was 1.2–2.5 years longer among those who had a smoker among their family members. The impact of best friend was even greater: Duration of smoking was 3.4 years longer among those

whose best friend in school had been a smoker. Those whose current best friend was a smoker had 3.6 years longer duration of smoking. (Table 4)

Table 4: Mean differences in age at smoking initiation and duration of smoking of those smoker/ex-smoker subjects who had a smoking family member or best friend at school age and those who did not. P-values come from the unpaired T-test.

| | | Smoking initiation | | | Duration of smoking | | |
|--------------------|------------------------|--------------------|--------------------|------------|---------------------|--------------------|------------|
| | | | | <i>p</i> - | | | <i>p</i> - |
| | | Age (years) | Difference (years) | value | Duration (years) | Difference (years) | value |
| Best friend | | | | | | | |
| | <i>In current life</i> | | 0.9 | <0.05 | | 3.6 | <0.001 |
| | Non-smoker | 16.5 | | | 8.6 | | |
| | Smoker | 15.6 | | | 12.2 | | |
| | <i>In school</i> | | 2.7 | <0.001 | | 3.4 | <0.001 |
| | Non-smoker | 17.9 | | | 8.0 | | |
| | Smoker | 15.2 | | | 11.4 | | |
| Mother* | | | 1.7 | <0.001 | | 2.5 | <0.001 |
| | Non-smoker | 16.7 | | | 9.4 | | |
| | Smoker | 15.0 | | | 11.9 | | |
| Father* | | | 0.8 | <0.05 | | 1.2 | <0.05 |
| | Non-smoker | 16.5 | | | 9.7 | | |
| | Smoker | 15.7 | | | 10.9 | | |

| | | | | | | |
|----|----------|------------|------|--------|------|-------|
| 1 | | | | | | |
| 2 | Brother* | | 1.0 | <0.05 | | 2.0 |
| 3 | | | | | | <0.05 |
| 4 | | Non-smoker | 16.4 | | 9.7 | |
| 5 | | | | | | |
| 6 | | Smoker | 15.4 | | 11.7 | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | Sister* | | 1.4 | <0.001 | | 1.7 |
| 10 | | | | | | <0.05 |
| 11 | | Non-smoker | 16.4 | | 9.9 | |
| 12 | | | | | | |
| 13 | | Smoker | 15.0 | | 11.6 | |
| 14 | | | | | | |
| 15 | | | | | | |

* When the respondent was in school age

In the share of smokers, the amount of tobacco products consumed did not differ according to the smoking behavior of current or school age best friend. Neither did those whose brother or sister smoked consume more tobacco products. On the other hand, 64.7% (n=44) of those who had a smoking mother smoked more than 20 cigarettes per day while only 38.7% (n=36) of those whose mother did not smoke smoked as heavily (p<0.05). A similar difference was seen in the smoking behavior of father; there was an 18.5 percentage point greater share of heavy (more than 20 cigarettes per day) smokers among those with smoking father in their schooldays (p<0.05).

DISCUSSION

This study ascertained the gravity of the implications of having a smoking parent, sibling or friend. The greatest impact on adult smoking comes from the current best friend. We see this as a result of orientation – we want a friend who reminds us of ourselves. People who smoke see smoking as a part of their self-image and

thus tend to make friends with other smokers. For many people smoking is an important field of social life and this also makes it a useful way of making friends.

The response rate (46.9%) is satisfactory since we had no incentive or other external motivator to increase the enthusiasm to respond. An important strength of this study is that it combines two different methods: cross-sectional questionnaire in 2008 and the longitudinal follow-up from the 1992 questionnaire. Earlier studies have focused mainly on groups like families, siblings or friends in general. We studied the influences of all the immediate family members (mother, father, sister, brother) and best friends both in schooldays and in adulthood, separately and from the same cohort. A recently published Finnish study concurs with our results about the importance of best friend's influence over family member influences [25]. This increases the reliability of our results. Unfortunately we did not have the prospectively measured information about the smoking behavior of the respondents' best friends.

A weakness of our protocol is that the smoking behavior of parents, siblings and best friends was determined by only one question. Thus we do not know about the heaviness of their smoking, periods of abstinence and if their possible smoking was clearly visible to the subject. These are, however, unlikely to cause any bias in our results since we were interested in whether the subjects felt they had had smokers among their family or friends.

The impact of a smoking best friend at school seems different but equally significant: earlier onset of smoking and longer lasting smoking habit was observed among those who had a smoking best friend at school. In an older

American study it was concluded that male best friends have a greater influence on smoking initiation [18]. In our results males seemed to be less influenced by their best friends in school than were females. However, our interest was more in the persistence of smoking to adulthood and from this type of data it is not possible to determine the direction of causality. The gender differences could be explained by differences in social networking between males and females [26]. Girls tend to form intense bilateral friendships while boys' social networks are in large packs with more loose bonds of friendship. We still do not know who influences whom when it comes to transferring smoking behavior from one friend to another.

Smoking behavior of males seems to be connected with the smoking behavior of family members. Among females the prospective analysis shows a connection with the smoking behavior of family members but the retrospective analysis does the opposite. Of all the family members studied the smoking behavior of mother had the greatest effect on the heaviness and persistence of the smoking habit. It seems that smokers who smoke due to family influences are different from those whose smoking initiation was influenced by friends. They consume more tobacco products and are thus likely to have a strong nicotine addiction [27].

Half of the cohort received up to four brief tobacco interventions while they were of school age. This is unlikely to cause any bias in our study since the intervention did not have an effect in long-term follow-up [28]. Recent evidence of cessation interventions is in line with our findings [29].

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2 Twin studies have shown that the heavier the smoking is in adolescence, the more
3
4 likely it is to continue in adulthood [30]. We did not measure the heaviness of
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6 smoking in adolescence but in our results the smoking behavior of parents was
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8 associated with the subjects' heaviness of smoking in adulthood. This emphasizes
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10 the importance of family influences. Our results can be generalized to
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12 industrialized populations.
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17 There are a vast number of studies considering methods of smoking cessation
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19 involving medical consultations. We want to emphasize that smoking prevention
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21 must not be seen as something only doctors can do. The onset of a lifelong
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23 smoking habit is usually in adolescence [31]. One can also say that if you do not
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25 start to smoke in adolescence, it is likely that you will not start to smoke at all.
26
27 The culture of emulation among growing adolescents, routine cessation programs
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29 for expectant parents, tobacco price policies, tobacco advertisement restrictions
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31 and impeding access to tobacco products are something we really need to take
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33 seriously if we want to quell the smoking epidemic. Only a very small part of this
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35 work can be done in the doctor's consultationroom, but it is important that the
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37 work that doctors do with their patients is consonant with the consistent anti-
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39 smoking strategies.
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48 CONCLUSIONS

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52 The smoking behavior of a best friend is significantly associated with subjects'
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54 own smoking behavior in adulthood. The impact of this association is much
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greater than the impact of smoking family members. This should be taken into consideration in attempts to prevent smoking initiation or continuation.

COMPETING INTERESTS

None declared.

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CONTRIBUTIONS

AJS designed the study, gathered and processed the data and wrote the paper, JK designed the study and wrote the paper, KJM supervised, designed the study, processed the data and wrote the paper. All authors contributed to and have approved the final manuscript

DATA SHARING STATEMENT

Extra data is available by e-mailing AJS.

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WHAT THIS PAPER ADDS?

The smoking influence of all family members and best friends both when in school age and in adulthood have been studied from the same population.

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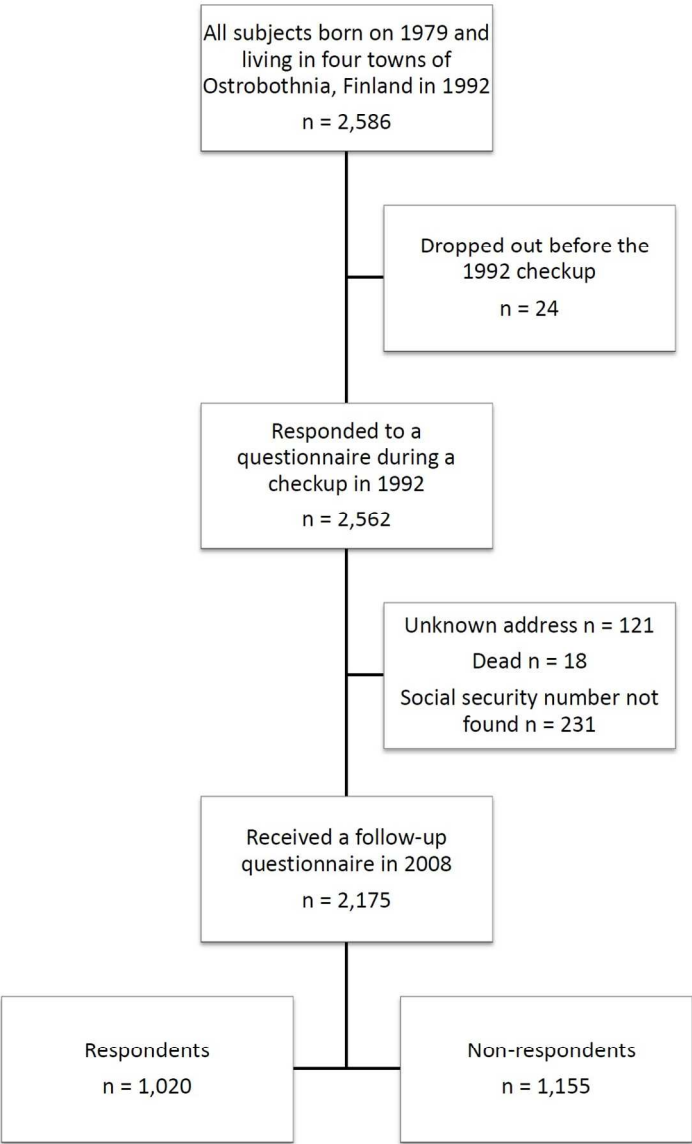
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FIGURE LEGEND

Figure 1: Flow-chart of the evolution of the cohort.

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Flow-chart of the evolution of the cohort.
338x528mm (96 x 96 DPI)

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

| | Item No | Recommendation |
|------------------------------|---------|---|
| Title and abstract | 1 | (a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found |
| Introduction | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses |
| Methods | | |
| Study design | 4 | Present key elements of study design early in the paper |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group |
| Bias | 9 | Describe any efforts to address potential sources of bias |
| Study size | 10 | Explain how the study size was arrived at |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses |
| Results | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount) |
| Outcome data | 15* | Report numbers of outcome events or summary measures over time |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period |

| | | |
|--------------------------|----|--|
| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses |
| Discussion | | |
| Key results | 18 | Summarise key results with reference to study objectives |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results |
| Other information | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based |

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

- The title has “a cohort study” in it.
 - See Abstract.
- See Introduction, especially the first page.
- See the final paragraph of Introduction – the aim is to ascertain the gravity of different social influences.
- See the beginning of Materials and methods – we describe the initial checkups and the follow-up and their schedule
- See Materials and methods.
- Again, see Materials and methods.
 - This was not a matched study.
- In Materials and methods.
- All data collection is specified whether the information came from the initial checkup or the follow-up.
- We write about the possibility of bias in Discussion.
- Study size was determined by the size of the age cohort. It was not based upon a power calculation.
- See Materials and methods before Statistical analysis.
- a), b) and d) See Statistical Analysis –chapter ; c) and e) We used Missing data later in Results to see if there were any factors associated with greater likelihood to drop out. Sensitivity analyses were not used.
- We have a flow-diagram about this. The reasons for not participating are not known – responses were voluntarily.
- We have a table about a), b) was not addressed in the text, but can be assessed by the reader through comparing the numbers of responses for each variable, c) in handled in the text.
- We use OR:s instead of numbers.
- a) we have a table about this, b) is explained in the text at Materials and methods, c) was not considered relevant
- Reported in the latter part of Results
- In the beginning of Discussion
- In Discussion

20. In Discussion.
21. In Discussion.
22. Included.

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The smoking habit of a close friend or family member – how deep is the impact? A cross-sectional study

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The smoking habit of a close friend or family member
– how deep is the impact? A cross-sectional study

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Keywords: Tobacco, Smoking, Family influence, Social influence

Word count: 2,379

ABSTRACT

Objectives: To assess the risk of becoming a smoker in adulthood associated with parental smoking as well as the smoking of siblings and close friends.

Design: A cross-sectional study.

Setting: Four oral health care centres in Finland and a follow-up.

Participants: An age cohort born in 1979 (n=2,586) and living in four Finnish towns. Of those reached by the 2008 follow-up, 46.9% (n=1,020) responded.

Primary and secondary outcome measures: Smoking behaviour at the age of 29. Smoking behaviour at the age of 13 and smoking behaviour of family members and close friends.

Results: Smoking of a current close friend was strongly associated with subjects' own smoking (OR 5.6, 95% CI 3.6–8.8). The smoking of a close friend during schooldays was similarly associated (OR 2.9, 95% CI 1.8–4.5). Smoking among males was associated with the smoking behaviour of mothers and siblings while that among females was not.

Conclusions: The impact of a smoker as a close friend is greater than that of a smoking parent or sibling in school age when it comes to smoking behaviour in adulthood. This should be taken into consideration when attempting to prevent smoking initiation or continuation.

Trial registration: At clinicaltrials.gov (NCT01348646).

ARTICLE SUMMARY

Article Focus

- Regarding the gravity of social influences in smoking behavior, which are more important – family members or close friends?

Key Messages

- If a close friend in adulthood smokes, one is also likely to smoke
- The second most important social influence for smoking comes from close friend of schooldays (at 13 years)

Strengths and Limitations

All the social influences on smoking were studied in the same population. A limitation is that the smoking behaviour of close friends and family members on schooldays was measured retrospectively.

INTRODUCTION

Smoking is an unhealthy and lethal habit. There is a linear association between the duration and heaviness of smoking and its negative impact on an individual's health. A persistent smoking habit greatly increases the risk of premature death [1]. If smoking disappeared from this world, millions of lives would be saved [2].

The development of nicotine dependence and smoking habit is linked to social influence from family and friends [3–6]. Children who are exposed to smoking at home are more likely to experiment with smoking [7, 8]. A smoking parent makes an adolescent more positively disposed to smoking. [9]. Smoking siblings also increase the risk of regular smoking [10]. Similar smoking patterns among family members can be partly explained through shared genes [11]. Adolescent cessation programmes including a parental approach have reported good results [12]. This emphasises the importance of family influences in adolescent smoking.

The smoking behaviour of peers has a great influence on adolescents' own smoking habits [13]. The influence of smoking peers seems to be greater than that of smoking parents when considering the likelihood of an adolescent starting to smoke [14–16] or continuing the habit from adolescence to adulthood [17]. There is also evidence that the increased risk of continuing smoking caused by a smoking peer is comparable to that caused by smoking parents [18]. A male best friend who smokes seems to have a greater effect on smoking initiation than a female best friend who smokes [19]. Genes seem to influence the choice of friends and thus indirectly influence adolescent smoking [20].

A variety of theories have been proposed regarding the association of social influence and smoking behaviour. Perceived influence theories try to explain this through adolescents' perceptions of their peers' smoking behaviour. In external influence theories the smoking behaviour of peers has a direct influence on adolescent smoking. Group level theories examine how differences in gender, race and subculture influence the relationships and thus smoking behaviour. [21]

Approximately one in four adult males and one in five adult females in Finland are regular smokers [22]. In Finland the smoking trends have been slightly diminishing in recent years. Nevertheless, the smoking rate among young adult females remains a significant issue and recent global evidence shows a rising trend in the smoking rates among females [23, 24].

The aim of this study was to ascertain the risk of becoming an adult smoker associated with parental smoking as well as the smoking of siblings and close friends. Although the importance of social influences in smoking behaviour are widely acknowledged, we wanted to compare the strength of these influences..

MATERIALS AND METHODS

The cohort consisted of all subjects born in 1979 and living in 1992 in the Finnish towns of Vaasa, Pietarsaari, Kokkola or Seinäjoki (n=2,582) [25]. (Figure 1). These towns are all located in a province with very similar school conditions. Of the age cohort 99.1% participated in a dental checkup in 1992. During the checkup they responded to a questionnaire and some oral questions. Their current

1 smoking behaviour and their intentions to experiment with smoking were elicited.
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3 The smoking rate in this population was 5.7% (n=148) at the beginning of the
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5 study and 19.4% (n=304) at the time of the final examination in 1994 [25]. Half
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7 the population received annual brief tobacco interventions during the period
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9 1992–1995. These interventions had no long-term effect on their smoking [26].
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11 A questionnaire was sent to the available cohort (n=2,175) in 2008 to addresses
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13 obtained from the Population Register Centre (Figure 1). The response rate was
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15 46.9% (n=1,020). Respondents were classified as smokers and non-smokers
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17 according to their responses to the question "Do you smoke?" (No/Yes).
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24 In the questionnaire the respondents were asked to look back at their smoking
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26 exposure in their schooldays. Our study was based on perceived influence theory
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28 and thus the respondent's own perception of his/her influences was of interest.
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30 The respondents answering "yes" to the question "When you were of school age,
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32 did your father smoke?" (No/Yes/Can't say) were deemed to have had a smoking
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34 father in their schooldays. The same pattern was repeated with similar questions
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36 about the smoking habits of mother, brother, sister and close friend during
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38 respondents' schooldays. Those without a brother (or a sister) were treated as
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40 missing data according to the question on smoking behaviour of their brother (or
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42 sister). The respondents answering "yes" to the question "Does your close friend
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44 smoke?" were deemed to currently have a smoking best friend.
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50 We also measured some potential confounders for smoking, namely marital status,
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52 level of education and self-perceived health. Marital status was elicited as
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54 Single/Married/Cohabiting/Remarried/Divorced/Widowed. Single, divorced and
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56 widowed respondents were classified as single, while in the analysis married,
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remarried and cohabiting respondents were classified as married or cohabiting. Education was classified as higher education if the respondent had a polytechnic or university degree. All other education was classified as lower education. Respondents' self-perceived health was also elicited as Very good/Good/Average/Poor/Very poor/Can't say. The responses were reclassified as Very good/Not very good, where all answers other than Very good were classified as Not very good.

A cover letter describing the purpose and methodology of the study and a consent form were enclosed with the questionnaires. Only completed questionnaires returned with a signed consent form were used as data. The Ethics Committee of the Pirkanmaa Hospital District, Finland approved the study protocol (R08017).

Analysis of non-response

We used the relevant measurements from the 1992 study to compare respondents to non-respondents (Table 1). Among respondents there were significantly more females and those who had not tried smoking by the age of 13. There were no differences between respondents and non-respondents according to smoking behaviour at the age of 13, willingness to try smoking (among those who were non-smokers at the age of 13) or smoking behaviour of parents.

Table 1: Comparison of the respondents and non-respondents to the 2008 follow-up according the baseline measurements from the 1992 questionnaire.

| <u>Respondents (n = 1020)</u> | <u>Non-respondents (n = 1155)</u> |
|-------------------------------|-----------------------------------|
|-------------------------------|-----------------------------------|

| | n | % of group | n | % of group | <i>p-value</i> |
|-----------------------------------|-----|------------|------|------------|----------------|
| Smoking at age 13 | | | | | 0.097 |
| No | 972 | 95.3 | 1441 | 93.7 | |
| Yes | 48 | 4.7 | 97 | 6.3 | |
| Gender | | | | | <0.001 |
| Female | 605 | 59.3 | 646 | 41.9 | |
| Male | 415 | 40.7 | 895 | 58.1 | |
| Experimentations at age 13 | | | | | <0.001 |
| Had not tried smoking | 585 | 60.4 | 727 | 50.9 | |
| Had tried smoking | 383 | 39.6 | 702 | 49.1 | |
| Attitude at age 13 | | | | | 0.83 |
| Not willing to try smoking | 661 | 94.3 | 916 | 93.9 | |
| Willing to try smoking | 40 | 5.7 | 59 | 6.1 | |
| Parent smoking | | | | | 0.18 |
| No | 584 | 60.3 | 821 | 57.5 | |
| Yes | 384 | 39.7 | 606 | 42.5 | |

Statistical analysis

We used IBM SPSS version 20.0 to conduct the statistical analyses. Binary logistic regression was used with 95% confidence interval (CI) and the depending variable was smoking (Yes/No) at the age of 29. Two binary outcome measures were compared with χ^2 -test. Missing data for a measurement was treated as non-response for that measure. Those who did not respond in the 2008 follow-up were treated as missing data for all measurements excluding those used for analysis of non-response (see below).

RESULTS

Of all respondents 16.9% (n=168) were smokers in 2008 (Table 2). Smoking rates were 14.4% (n=86) among females and 20.4% (n=82) among males (p<0.05). The majority of respondents was married or cohabiting, had higher education and perceived their health to be very good (Table 2).

Table 2: Comparison of the cohort characteristics in the 1992 study and in the 2008 follow-up.

| | 1992 initial study | | 2008 follow-up | |
|-------------------------|--------------------|------------|----------------|------------|
| | (mean age 13) | | (mean age 29) | |
| | n | % of group | n | % of group |
| Gender | | | | |
| Female | 1,251 | 48.8 | 596 | 59.8 |
| Male | 1,310 | 51.2 | 401 | 40.2 |
| Smoking behavior | | | | |
| Smoker | 145 | 5.7 | 168 | 16.9 |
| Non-smoker | 2,413 | 94.3 | 829 | 83.1 |
| Marital status | | | | |
| Single | - | - | 221 | 34.5 |
| Married or cohabiting | - | - | 775 | 65.5 |
| Education | | | | |
| Lower | - | - | 338 | 34.2 |
| Higher | - | - | 651 | 65.8 |

Self-perceived health

| | | | | |
|---------------|---|---|-----|------|
| Very good | - | - | 866 | 86.9 |
| Not very good | - | - | 130 | 13.1 |

The majority of smokers had lower education while only less than one third of non-smokers had lower education (Table 3). This difference was statistically significant. A statistically significant difference was found between smokers' and non-smokers' self-perceived state of health. One in ten non-smokers but one in four smokers reported their self-perceived health to be other than very good (Table 3). There were also statistically significantly more females among non-smokers (Table 3).

Table 3: Comparison of smokers and non-smokers according to the measured potential confounders.

| | Smokers (n = 168) | | Non-smokers (n = 829) | | <i>p-value</i> |
|-----------------------|-------------------|------------|-----------------------|------------|------------------|
| | n | % of group | n | % of group | |
| Gender | | | | | 0.016 |
| Female | 86 | 51.2 | 510 | 61.5 | |
| Male | 82 | 48.8 | 319 | 38.5 | |
| Marital status | | | | | 0.155 |
| Single | 44 | 26.3 | 177 | 21.4 | |
| Married or cohabiting | 123 | 73.7 | 652 | 78.6 | |
| Education | | | | | <0.001 |

| | | | | |
|-----------------------|-----|------|-----|--------|
| Lower | 94 | 56.6 | 244 | 29.6 |
| Higher | 72 | 43.4 | 579 | 70.4 |
| Self-perceived health | | | | <0.001 |
| Very good | 121 | 72.0 | 745 | 90.0 |
| Not very good | 47 | 28.0 | 83 | 10.0 |

There was a strong connection with the smoking behaviour of the current close friend. Among those males who currently had a smoking close friend it was 7.1 (95% CI 3.6-14.0) times more likely that they, too, were smokers. This connection was slightly weaker but still significant among females (OR 4.7, 95% CI 2.5-8.6). Among females having a smoker as a close friend in school was connected with more than five times greater likelihood of being a smoker in adulthood (OR 5.1, 95% CI 2.6-10.0). No connection with smoking behaviour of close friend in school was observed in males. Smoking of mother, brother or sister when the subject was of school age increased the likelihood of being a smoker more than twofold among males, but the smoking habit of any family member had no effect among females. The smoking behavior of father when the subject was of school age did not have a connection with subject's smoking behavior in adulthood.

In the adjusted model we combined all the family members and best friends (both current and in schooldays) with the measured confounders into a multivariate logistic regression (Table 4). The impact of friends (current or in schooldays) persisted in the adjusted model while that of all the family members disappeared

(Table 4). Self-perceived health and marital status had an independent connection with smoking behaviour in adulthood, but the strength of these connections was less than that of the influence of close friends.

Table 4: Logistic regression analysis of all respondents according to their own smoking behaviour and the smoking behaviour of their family members and friends with the potential confounding factors. All OR:s are multivariate including all tabulated variables. Depending variable was smoking at the age of 29. OR = Odds Ratio, CI = Confidence Interval.

| | | OR for being smoker (95% CI) | p-value |
|------------------------|------------|------------------------------|------------------|
| Close friend | | | |
| <i>In current life</i> | | | <0.001 |
| | Non-smoker | 1 | |
| | Smoker | 5.0 (3.1-7.8) | |
| <i>In school</i> | | | <0.001 |
| | Non-smoker | 1 | |
| | Smoker | 3.1 (1.9-5.0) | |
| Mother | | | 0.06 |
| | Non-smoker | 1 | |
| | Smoker | 1.7 (1.0-2.8) | |
| Father | | | 0.7 |
| | Non-smoker | 1 | |
| | Smoker | 1.1 (0.7-1.8) | |
| Sister | | | 0.8 |
| | Non-smoker | 1 | |
| | Smoker | 1.7 (0.9-3.0) | |
| Brother | | | 0.9 |
| | Non-smoker | 1 | |
| | Smoker | 1.6 (0.9-2.7) | |
| Gender | | | 0.14 |
| | Female | 1 | |
| | Male | 1.4 (0.9-2.2) | |
| Marital status | | | 0.012 |

| | | | |
|-----------------------|-----------------------|---------------|-------|
| | Married or cohabiting | 1 | |
| | Single | 2.0 (1.2-3.3) | |
| Education | | | 0.08 |
| | Higher | 1 | |
| | Lower | 1.5 (1.0-2.4) | |
| Self-perceived health | | | 0.008 |
| | Very good | 1 | |
| | Not very good | 2.3 (1.2-4.1) | |

DISCUSSION

This study ascertained the gravity of the implications of having a smoking parent, sibling or friend. The greatest impact on adult smoking comes from the current close friend. We see this as a result of orientation – we want a friend who reminds us of ourselves. We think that people who smoke see smoking as a part of their self-image and thus tend to have friends who also are smokers. Friends who smoke increase the likelihood of their friends continuing smoking [27].

Earlier studies have focused mainly on groups like families, siblings or friends in general. We studied the influences of all the immediate family members (mother, father, sister, brother) and close friends both in schooldays and in adulthood, separately and from the same cohort. A recently published Finnish study concurs with our results about the importance of best friend’s influence over family member influences [28]. This increases the reliability of our results. Our population is representative of Finns and our results can be generalised to comparable populations.

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4 In an older American study it was concluded that male best friends have a greater
5 influence on smoking initiation [19]. In our results males seemed to be less
6 influenced by their best friends in school than were females. However, our interest
7 was more in the persistence of smoking to adulthood and from this type of data
8 the direction of causality cannot be determined. The gender differences could be
9 explained by differences in social networking between males and females [29].
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11 Girls tend to form intense bilateral friendships while boys' social networks are in
12 large packs with looser bonds of friendship. We still do not know who influences
13 whom when it comes to transferring smoking behaviour from one friend to
14 another.
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31 Innumerable studies have considered methods of smoking cessation involving
32 medical consultations. We want to emphasise that smoking prevention must not
33 be seen as something only doctors can do. The onset of a lifelong smoking habit is
34 usually in adolescence [30]. One can also say that if a person does not start to
35 smoke in adolescence, that person is unlikely to start to smoke at all. The culture
36 of emulation among growing adolescents, routine cessation programmes for
37 expectant parents, tobacco price policies, tobacco advertisement restrictions and
38 impeding access to tobacco products are something we really need to take
39 seriously if we want to quell the smoking epidemic. Only a very small part of this
40 work can be done in the doctor's consultation room, but it is important that the
41 work that doctors do with their patients is consonant with the consistent anti-
42 smoking strategies. The results of this study demonstrate the great importance of
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close friends' influence. This should be noted as an advantage for planning anti-smoking actions addressing social influences.

Limitations

The response rate (46.9%) was low but satisfactory since we had no incentive or other external motivator to increase the inclination to respond. We concede that selection bias had an effect on our results: in 1992 almost one of two respondents were female but in the 2008 follow-up three of five respondents were female. The smoking rates among our study population were lower than those reported by population studies in Finland [22] and this is likely to be caused by response bias. Most respondents had higher education and very good self-perceived health. Thus it is likely that many of those with health problems and lower education did not respond to the 2008 follow-up. This affects our results: it is likely that there were more adult smokers among the non-respondents.

We did not elicit parental occupation, parental income or parental education. Thus these potential confounders may have affected our results. We did not measure the smoking behaviour of the respondents' schooldays close friends prospectively and thus it is possible that the close friend was recalled incorrectly.

A weakness of our protocol is that the smoking behaviour of parents, siblings and close friends was determined by only one question. Thus we do not know about the heaviness of their smoking, periods of abstinence and if their possible smoking was clearly visible to the subject. These are, however, unlikely to have

caused any bias in our results since we were interested in whether the subjects felt they had had smokers among their family or friends.

CONCLUSIONS

The smoking behaviour of a close friend is significantly associated with subjects' own smoking behaviour in adulthood. The impact of this association is much greater than the impact of smoking family members. This should be taken into consideration in attempts to prevent smoking initiation or continuation.

COMPETING INTERESTS

None declared.

FUNDING

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CONTRIBUTIONS

AJS designed the study, gathered and processed the data and wrote the paper, JK designed the study and wrote the paper, KJM supervised, designed the study, processed the data and wrote the paper. All authors contributed to and have approved the final manuscript

DATA SHARING STATEMENT

Extra data is available by e-mail AJS.

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WHAT THIS PAPER ADDS?

The smoking influence of all family members and close friends both during school age and in adulthood were studied in the same population in order to

compare the strength of the influences. This makes it possible to compare the effects of genetic and epigenetic influences on smoking in adulthood.

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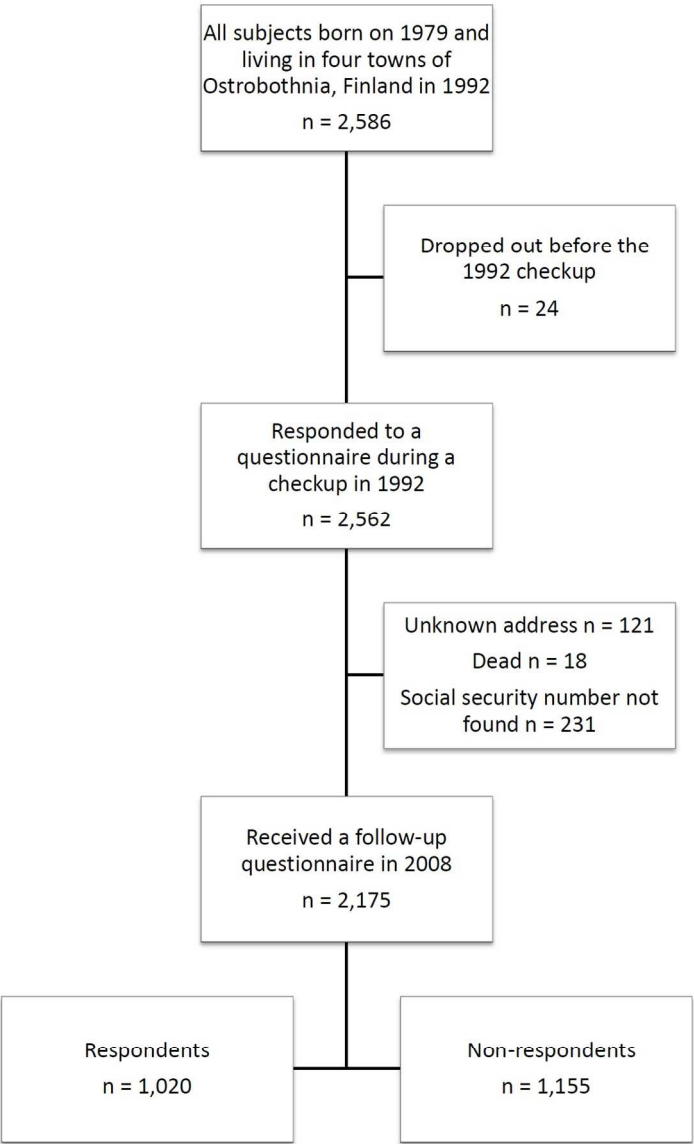
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FIGURE LEGEND

Figure 1: Flow-chart of the evolution of the cohort.

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Flow-chart of the evolution of the cohort.
338x528mm (96 x 96 DPI)

Dear Editor Sands,

We want to thank both reviewers for their comments on our manuscript. We have now carefully revised it reacting to the reviewer's questions, comments and corrections. Some data of less significance were deleted from the last revision to emphasize the message and key findings of our manuscript. We hope you will find our revisions adequate to make this a publication via BMJ Open.

We will now go through all the comments of the reviewers and the actions taken in the revision. For the sake of clarity all the reviewer's comments appear in *italics*.

First the comments by Dr. Vanessa Johnston:

1. One overall comment I have is that in parts, the standard of written English is not at a high enough standard for an academic publication. I can only imagine that it must be challenging to write an academic publication in a language that is not your first language, but the style in sections is confusing to the reader and makes interpretation of the results and discussion, in particular, difficult. I would recommend that this paper is edited by a native English speaker if possible.

It is true that English language is not our first language, but the text was in fact checked by native English speaker, likewise this revised version.

2. The 3rd paragraph describing the evidence on which social influences are most important in determining youth uptake and smoking progression is not as clear cut as the authors present. My reading of the literature is that the effect of family smoking is particularly relevant for younger children, whereas peer group behaviours are more important in influencing smoking during teenage years. More recent longitudinal research suggests parental influences are important for initiation and escalation of smoking. Peer behaviour too, has been found to affect initiation, progression and trajectories. If the evidence was so clear about which social influences are most relevant and at which time points, then what is the rationale for this study? Other than perhaps to test the established evidence in the Finnish context. I think the rationale for this study could be made more strongly.

Comparing the different social effects was the point of this study. We now explain it more thoroughly in the last paragraph of the Introduction.

3. The 4th paragraph sets out the social theory behind social influence and smoking behaviour. This again needs some more detail. In perceived influence theories, is smoking among peers perceived as the norm?

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How does smoking behaviour of peers directly influence smoking – through peer pressure or some other/additional mechanism? I note that in the discussion the authors state they were only interested in whether smokers perceived they had smokers among their family and friends – presumably, referencing the perceived influence theories they introduce in the introduction. This needs to be described in the methods.

Our study was based on perceived influence theory. This is now described in the third paragraph of the Methods section.

4. In the 6th paragraph the authors introduce the cohort study conducted in Finland. At first the relevance of this was unclear to me. There needs to be a stronger link between this study and the aim of the current paper in the introduction. The details about the cohort study should be moved to the methods. What does “very homogenous school conditions” mean?

This information has now been moved to the first paragraph of the Methods section. The word “homogenous” has been replaced with “similar”. This refers to the common rural orientation, demographics, and economic conditions in these schools.

5. The stated aim does not capture other results that are presented in the paper: the association between smoking attitudes at age 12 and smoking and the association of family/friends smoking and age of initiation/duration/intensity of smoking.

We decided to omit the results about age at initiation and duration of smoking, likewise the results about the heaviness of smoking. Thus these are not included in the study aims. Smoking attitudes are now only used for analysis of nonresponse and thus are not mentioned in the study aims.

Methods

6. I would suggest describing the details of the questions that were asked regarding smoking in the methods section (currently repeated in intro and methods).

These details now remain only in the Methods section.

7. Was there any data about parental income/education/occupation, as this might be a confounding factor?

Unfortunately these confounders were not measured during data collection. This is a limitation of our study and is thus mentioned in the Discussion, new “Limitations” section.

8. Some background about why a birth cohort had a dental check-up at age 12 would be interesting. Is this a universal health check-up in Finland?

In Finland all children had dental check-ups annually during the 1990's. This is not mentioned in the text since it does not affect the results in any way.

9. Calculation of duration of smoking for smokers and ex-smokers was quite crude as it did not take into account any quit periods – this should be acknowledged in limitations.

We no longer mention the duration of smoking in our manuscript. We agree that our calculation method was rather imprecise.

10. Number of cigarettes was used as a measure of intensity of consumption. What about roll-your-own cigarettes made from loose tobacco? How was this accounted for?

Heaviness of smoking is no longer mentioned in the manuscript. The respondents were, however, asked to estimate their tobacco consumption in cigarettes if they used pipe or loose tobacco.

11. I am uncertain why participants were asked in 2008 about the smoking behaviour of their parents when this was asked in 1992? What data on parental smoking was used for the different analyses?

The questions differed from each other. In 1992 they were asked if one or both of their parents smoked and in 2008 if their mother smoked when they were of school age with a similar question about their father. The question asked in 1992 is now used for analysis of nonresponse (see additions to the Methods section). In the Results we use solely the responses to the 2008 follow-up.

12. Was the author's measure of self-rated health a standardised measure?

Self-rated health has been used in many cross-sectional and cohort studies we know of. For example, the HeSSup study with its numerous publications uses the same method for grading self-perceived health. For example see: Suominen S, Koskenvuo K, Sillanmäki L, Vahtera J, Korkeila K, Mattila K, Virtanen P, Sumanen M, Rautava P, Koskenvuo M. Non-response in a nationwide follow-up postal survey in Finland: A register-

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13. *“In this study we combined two different settings” is a confusing statement. I think what is meant is “In this study we combined two different research designs.”*

Now we use only the cross-sectional design and this sentence has been removed from the paper.

14. *I don’t believe the second “setting” was retrospective; it was a cross-sectional analysis only. Can the authors please confirm or clarify this.*

We now renamed the setting cross-sectional instead of retrospective. This change has been made to the title as well.

15. *There needs to be more detail in the statistical analysis section, including on adjustment for potential confounders and how missing data and loss to follow-up was addressed.*

We now provide more detail in the Statistical analysis section.

Results

16. *As the authors note there was a large loss to follow up. It would be useful to see a comparison between those retained and those lost (by gender, smoking status at age 13, smoking attitudes) to ascertain how different these groups are.*

We have done the advised analysis and the results are presented as Analysis of non-response (in the Methods section).

17. *I see from Table 1 that the % of women at follow-up was greater than at baseline. This should also be acknowledged in discussion when discussing loss to follow up.*

We now acknowledge the selection bias of females in Limitations (Discussion).

18. *Table 1 should include the denominators in the first row and should consider adding the denominators for smoking behavior. I would suggest adding median or mean age in this table as well.*

We consider the table (renamed Table 2) quite self-explanatory as it is. We added mean ages to the row headings.

19. *The writing style in the following sentence is confusing and needs some editing:*

"Smokers also differed statistically significantly from non-smokers with regard to their self-perceived health; more than one out of four smokers had not very good self-perceived health while only one of ten non-smokers had other than very good self-perceived health (Table 2). There were also statistically significantly more females among non-smokers (Table 2)" (p.9)

Language help was given to us by a native English speaker, who corrected the sentence for greater clarity.

20. *Table 2 – heading should include the year 2008 somewhere for clarity "Prospective setting" should read "prospective study."*

The prospective analysis section has now been removed from the paper and this heading no longer exists.

21. *These following few sentences are confusing. Do the authors mean "Twenty-four percent of smokers in 2008 reported having a smoking parent in 1992, compared to 11.7% of non-smokers"? "There were 24.1% (n=99) smokers in 2008 among those who reported having a smoking parent or smoking parents in the 1992 questionnaire, while only 11.7% (n=68) of those with the opposite response smoked (p<0.001). Females did not differ statistically significantly from males according to the results on this question: OR for being smoker was 2.0 (1.3–3.3) for females and 2.6 (1.5–4.7) for males with smoking parent(s)." (p.10-11)*

Yes, we did, but now we no longer use these results in the paper.

22. *Why was an OR used and not relative risk?*

OR comes from the logistic regression analysed using SPSS for Windows v. 20.0. We think both OR and RR represent the same phenomenon and are both acceptable, but only use one in the same paper.

23. *"Cross-sectional setting" should read "cross-sectional study."*

This has been corrected.

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24. *The following sentences I believe should be moved to the prospective section. “Having a smoker as a best friend in school was connected with more than five times greater likelihood of being a smoker in adulthood in females, but not in males. Smoking of mother, brother or sister when the subject was of school age increased the likelihood of being a smoker more than twofold among males, but not among females. The smoking behavior of father when the subject was of school age did not have a connection with smoking behavior in adulthood. (Table 3)”(p.11-12)*

We now present all results under one heading and there no longer exists a prospective study –section. We hope this improves the readability of our paper.

25. *Table 3 – I don’t suggest tabulating univariate and multivariate analyses together in the same table. Consider summarising the univariate data in text and only tabulating the multivariate analysis. Should include self-perceived health and marital status in multivariate table.*

We now have only the multivariate analysis in the table, univariate results are summarised in the Results. We also added education, self-perceived health and marital status to the multivariate table.

26. *Table 4 is confusing. Are the comparisons between smokers and ex-smokers or for smoker/ex-smoker participants who answered yes and no to each of the criteria (e.g. best friend smoking) Analyses on age of initiation, duration and intensity are all univariate and I don’t believe you can draw strong conclusions from them, as they are not adjusted for potential confounders.*

The table has been removed from the paper since we decided to concentrate on the primary aim of the study and improve the clarity of our findings.

Discussion

27. *I think the discussion is the weakest section of this paper. I believe some of the conclusions are too far reaching for the results presented in this study, particularly in relation to the conclusions drawn about the influence of family and friends on initiation, duration and intensity which are all based on univariate analyses.*

Now we no longer discuss the results that were based on the univariate analyses since these results have also been removed from the Results section.

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3 28. The limitations too are not adequately addressed. The response rate is low and this will bias results as
4 demonstrated by the fact that more women were in the follow-up sample. Additionally, the majority of this
5 sample had higher education and had very good self-rated health. What about recall and reporting bias that
6 are potential sources of bias in studies that rely on self-reported questionnaires.
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11 We now mention these limitations in the Limitations section. However, the majority of Finns born in 1970's
12 actually have higher education so the representativeness of our study population can be considered
13 satisfactory.
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17 29. The authors introduce new information on p.17 in the discussion – that half of the cohort received brief
18 tobacco interventions during school. This needed to come in earlier (in methods, when describing the
19 original cohort study).
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24 We now mention the brief tobacco interventions in the Methods section.
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27 30. It is unclear what the authors mean by "recent evidence of cessation interventions is in line with our
28 findings."(p.17 para 3)
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32 This paragraph has been omitted.
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36 31. The interpretation of the findings in the context of existing literature also needs to be strengthened. The
37 first paragraph has no referencing attached to multiple statements about the role of friends in influencing
38 smoking behaviour.
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42 We now include some references to support our insights, which have also been reworded for greater
43 clarity.
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46 32. Para 2, p.16 – references a Finnish study that concurs with the results of this study. What about
47 international literature?
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51 We think the setting of the referenced study was so similar to the one we used that its concurring results
52 greatly enhanced the reliability of our results. The matter has – of course – been reported in many other
53 journals from which we could have picked a reference.
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33. While the concluding paragraph describes how smoking prevention needs to be a comprehensive, multi-pronged approach, it does not address strongly enough potential points of intervention based on what this study has found – that is, the influence of friends and the friendship group on smoking behaviour.

This matter has now been more thoroughly addressed at the end of the Discussion section.

34. As to the external validity of this study, I am not convinced. As stated, the majority of this sample had higher education and very good self-rated health. How do these variables, as well as smoking prevalence among the cohort in 2008 compare with the wider Finnish population? Is it representative?

As mentioned earlier, we consider the population representative. The majority of Finns take higher education.

Second, the comments by Dr. Jacqueline M. Vink:

35. The overview of papers describing the relation between smoking initiation and smoking family members of friends is not complete. The authors do not mention the possibility that family members show similar smoking behavior due to shared genes. Papers exploring the association between smoking family members and the uptake of smoking, taking genetic factors into account, should be included in the introduction (for example: Twin Research 2003, 6(3), pp. 209-217 and/or twin and heritability studies).

We made an addition with a reference to the Introduction about the aspect of shared genes.

36. The authors mention that smoking rate among young adult females remains a significant issue , but do not mention what the prevalence of smoking is in this group (in general prevalence of smoking seems to be lower in females than males according to the previous sentence in the introduction).

We now explain the trend more clearly in the Introduction.

Method:

37. Duration of smoking was calculated for smokers by subtracting age at initiation from 29 -> but what if someone started smoking at 16, quit at 18 but started again at 28? Than he/she only smoked for 3 years, but according to this calculation it will be 13 years... Same question for the calculation for ex-smokers.

We decided to omit the analysis considering the duration of smoking and/or age at initiation from the paper to clarify our message.

38. Only t-tests or chi-square tests were used. Did the authors consider a regression analysis including all available variables?

We did indeed conduct a binary logistic regression for the essential variables (see for example Table 3 in the previous and Table 4 in this revised version) and now we tabulate only the multivariate analysis including those found to be potential confounders (statistically different measurements among smokers and non-smokers).

Results

39. Smoking rates are lower (14.4% in females and 20.4% in males) in the study sample compared to the general population (1 in 4 males and 1 in 5 females smokes according to the introduction). Is this due to response bias?

Probably. This matter has now been added to the Limitations section in the Discussion.

40. Authors conclude that some associations (for example influence of smoking mother on smoking in males) are significant (for example $p=0.04$) but did they consider to correct for multiple testing?

We did these multivariate analyses but the associations were non-significant after adjustment for confounders. We chose to omit some of the Results (including this) to clarify the point of this paper. Thus this conclusion has also been removed.

41. To predict the influence of smoking family members and best friend on smoking behavior in adulthood, it might be (more) interesting to select never-smokers at the age of 13 instead of including the total group. It might be interesting to explore the influence of smoking mother, father, brother, sister on smoking behavior separately for males and females because of possible sex differences. See also previous literature on this topic.

We think the family influences begin to affect individuals' health behavior (including attitudes towards smoking) much earlier and thus such a never-smokers study should be initiated at a very young age, even before school. We agree that this kind of approach would be interesting.

42. Question about Table 4: what happened if someone did not have a brother or a sister? Was this person not included in the analyses?

Those without a brother or a sister were excluded from the analysis on the family member in question since they could not respond anything on the question. We made an addition about this to the Methods.

43. Were all analyses done separately for mother, father, brother, sister etcetera? Did the authors consider to do a regression analyses including all variables at the same time to see whether significant associations remained significant when corrected for the other variables? And if yes, how much variance was explained by this model?

We did this analysis (see Table 3 in the previous version and Table 4 in the revised version), but variance was not included since we present 95% confidence intervals which also demonstrates the variance.

Discussion

44. Why do the authors think their results can be generalized to industrialized populations? Sample size is rather small, results are inconclusive?

Our population is representative on Finns and thus we now agree that generalisation could only be done to Finnish populations and comparable populations. This in mentioned in the Discussion.

45. In my opinion, the suggestions that are described in the last part of the discussion (about smoking prevention and the role of doctors and others) cannot be concluded from the results described in this paper. There is much more literature on this topic (influence of smoking family and friends), which should be included in the introduction/discussion.

Conclusions have now been extended to include the key points of this particular study.

46. Authors should make clear what their results add to the existing literature.

This has been explained more thoroughly in “What this paper adds”. It has earlier been known that family influences and peer influences are important in smoking behavior. In our setting it is possible to compare the effects of genetic and epigenetic influences for smoking in adulthood.

With best regards,

Antti J. Saari

STROBE Statement—Checklist of items that should be included in reports of *cohort studies*

| | Item No | Recommendation |
|------------------------------|---------|---|
| Title and abstract | 1 | (a) Indicate the study's design with a commonly used term in the title or the abstract (b) Provide in the abstract an informative and balanced summary of what was done and what was found |
| Introduction | | |
| Background/rationale | 2 | Explain the scientific background and rationale for the investigation being reported |
| Objectives | 3 | State specific objectives, including any prespecified hypotheses |
| Methods | | |
| Study design | 4 | Present key elements of study design early in the paper |
| Setting | 5 | Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection |
| Participants | 6 | (a) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up (b) For matched studies, give matching criteria and number of exposed and unexposed |
| Variables | 7 | Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable |
| Data sources/ measurement | 8* | For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group |
| Bias | 9 | Describe any efforts to address potential sources of bias |
| Study size | 10 | Explain how the study size was arrived at |
| Quantitative variables | 11 | Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why |
| Statistical methods | 12 | (a) Describe all statistical methods, including those used to control for confounding (b) Describe any methods used to examine subgroups and interactions (c) Explain how missing data were addressed (d) If applicable, explain how loss to follow-up was addressed (e) Describe any sensitivity analyses |
| Results | | |
| Participants | 13* | (a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed (b) Give reasons for non-participation at each stage (c) Consider use of a flow diagram |
| Descriptive data | 14* | (a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders (b) Indicate number of participants with missing data for each variable of interest (c) Summarise follow-up time (eg, average and total amount) |
| Outcome data | 15* | Report numbers of outcome events or summary measures over time |
| Main results | 16 | (a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included (b) Report category boundaries when continuous variables were categorized (c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period |

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| Other analyses | 17 | Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses |
| Discussion | | |
| Key results | 18 | Summarise key results with reference to study objectives |
| Limitations | 19 | Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias |
| Interpretation | 20 | Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence |
| Generalisability | 21 | Discuss the generalisability (external validity) of the study results |
| Other information | | |
| Funding | 22 | Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based |

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at <http://www.strobe-statement.org>.

- The title has “a cohort study” in it.
 - See Abstract.
- See Introduction, especially the first page.
- See the final paragraph of Introduction – the aim is to ascertain the gravity of different social influences.
- See the beginning of Materials and methods – we describe the initial checkups and the follow-up and their schedule
- See Materials and methods.
- Again, see Materials and methods.
 - This was not a matched study.
- In Materials and methods.
- All data collection is specified whether the information came from the initial checkup or the follow-up.
- We write about the possibility of bias in Discussion.
- Study size was determined by the size of the age cohort. It was not based upon a power calculation.
- See Materials and methods before Statistical analysis.
- a), b) and d) See Statistical Analysis –chapter ; c) and e) We used Missing data later in Results to see if there were any factors associated with greater likelihood to drop out. Sensitivity analyses were not used.
- We have a flow-diagram about this. The reasons for not participating are not known – responses were voluntarily.
- We have a table about a), b) was not addressed in the text, but can be assessed by the reader through comparing the numbers of responses for each variable, c) in handled in the text.
- We use OR:s instead of numbers.
- a) we have a table about this, b) is explained in the text at Materials and methods, c) was not considered relevant
- Reported in the latter part of Results
- In the beginning of Discussion
- In Discussion

20. In Discussion.
21. In Discussion.
22. Included.

For peer review only

The smoking habit of a ~~close~~^{best} friend or family member – how deep is the impact? A ~~cohort~~^{study} ~~cross-sectional study~~

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Keywords: Tobacco, Smoking, Family influence, Social influence

Word count: ~~2,526~~⁴⁹⁷~~2,379~~

ABSTRACT

Objectives: To ~~assess~~ ~~quantify~~ the risk of becoming a smoker in adulthood associated with parental smoking as well as the smoking of siblings and ~~close~~~~best~~ friends.

Design: ~~Prospective and retrospective cohort study.~~ A cross-sectional study.

Setting: Four oral health care centres in Finland and a follow-up.

Participants: An age cohort born in 1979 (n=2,586) and living in four Finnish towns. Of those reached by the 2008 follow-up, 46.9% (n=1,020) responded.

Primary and secondary outcome measures: Smoking behaviour ur at the age of 29. Smoking behaviour ur at the age of 13 and smoking behaviour of family members and ~~close~~~~best~~ friends.

Results: Smoking of a ~~current~~ ~~close~~~~best~~ friend ~~in current life~~ was strongly associated with subjects' own smoking (OR 5.6, 95% CI 3.6–8.8). The smoking of a ~~close~~~~best~~ friend during schooldays was similarly associated (OR 2.9, 95% CI 1.8–4.5). Smoking among males was associated with the smoking behaviour ur of mothers and siblings while that ~~among~~~~of~~ females was not. ~~Those smokers whose parents smoked when they were at school were heavier smokers in adulthood.~~

Conclusions: The impact of a smoker as a ~~best~~~~close~~ friend is greater than that of a smoking parent or sibling in school age when it comes to smoking behaviour ur in adulthood. This should be taken into consideration when attempting to prevent smoking initiation or continuation.

Trial registration: At clinicaltrials.gov (NCT01348646).

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ARTICLE SUMMARY

Article Focus

- ~~Regarding~~~~When considering~~ the gravity of social influences in smoking behavior, which are more important – family members or ~~close~~~~best~~ friends?

Key Messages

- If ~~a~~ ~~close~~~~one's best~~ friend in adulthood smokes, one is also likely to smoke
- The second most important social influence for smoking comes from ~~the~~ ~~close~~~~best~~ friend ~~of~~ ~~in~~ schooldays (at 13 years)
- ~~Smoking family members have an impact on the smoking behavior of~~
~~males, but not on females~~

Strengths and Limitations

All the ~~studies~~ social influences on smoking were studied ~~in~~~~from~~ the same population. A limitation is that the smoking behaviour of ~~close~~~~best~~ friends and ~~siblings~~~~family members~~ on schooldays ~~was~~~~ere~~ measured retrospectively.

INTRODUCTION

Smoking is an unhealthy and lethal habit. There is a linear association between the duration and heaviness of smoking and its negative impact on an individual's health. A persistent smoking habit greatly increases the risk of premature death [1]. If smoking disappeared from this world, millions of lives would be saved [2].

The development of nicotine dependence and smoking habit is linked to social influence from family and friends [3–6]. Children who are exposed to smoking behavior at home are more likely to experiment with smoking [7, 8]. A smoking parent makes an adolescent more positively disposed to smoking. [9]. Smoking siblings also increase the risk of regular smoking [10]. Similar smoking patterns among family members can be partly explained through shared genes [11]. Adolescent cessation programmes including a parental approach have reported good results [12]. This emphasises the importance of family influences in adolescent smoking.

The smoking behaviour of peers/friends has a great influence on adolescents' own smoking habits [13]. The influence of smoking peers/friends seems to be greater than that of smoking parents when considering the likelihoodness of an adolescent to start smoking [14–15] or continuing the habit from adolescence to adulthood [16]. There is also evidence that the increased risk of continuing smoking caused by a smoking peer/friend is comparable to that caused by smoking parents [17]. A male best friend who smokes seems to have a greater effect on smoking initiation than a female best friend who smokes [18]. Genes seem to

influence the choice of friends and thus indirectly influence adolescent smoking
[1920].

There are a variety of theories have been proposed regarding the association of
social influence and smoking behaviour. Perceived influence theories try to
explain this through adolescents' perceptions of their peers' smoking behaviour. In
external influence theories the smoking behaviour of peers has a direct influence
on adolescent smoking. Group level theories examine how differences in gender,
race and subculture influence the relationships and thus smoking behaviour. [210]

Approximately one in four adult males and one in five adult females in Finland
are regular smokers [224]. In Finland the smoking trends have been slightly
diminishing in recent years. Nevertheless, the smoking rate among young adult
females remains a significant issue and recent global evidence shows a rising
trend in the even worse smoking rates among females [232, 243].

During the period 1992–1994 a study was carried out in the Finnish regions of
Southern and Central Ostrobothnia, in the towns of Vaasa, Pietarsaari, Kokkola
and Seinäjoki [24]. These towns form a province with very homogenous school
conditions. The cohort (n=2,582) responded to questions and a questionnaire
during a school dental checkup. Their and their parents' smoking behavior and
attitudes towards smoking were elicited. The smoking rate in this population was
5.7% (n=148) at the beginning of the study and 19.4% (n=304) during the final
examination in 1994 [24].

The aim of this study was to ascertain the risk of becoming an adult smoker associated with parental smoking as well as the smoking of siblings and ~~close~~^{best} friends. ~~Although the importance of social influences in smoking behaviour are widely~~^{largely} acknowledged, we wanted to compare the ~~strength~~^{gravity} of these influences. ~~and thus studied them from the same population.~~

MATERIALS AND METHODS

The cohort consisted of all subjects born in 1979 and living in 1992 ~~in the Finnish towns of Vaasa, Pietarsaari, Kokkola or Seinäjoki (n=2,582) [254]. in one of the previously mentioned four towns~~ (Figure 1). ~~These towns are all located in~~^{form a} province with very similar school conditions. Of the age cohort 99.1% participated in a dental checkup in 1992. During the checkup they responded to a questionnaire and some oral questions. Their current smoking behaviour and their intentions to experiment with smoking were elicited. ~~There were also questions about the smoking behavior of their parents and their parents' attitudes to adolescents' smoking.~~ The smoking rate in this population was 5.7% (n=148) at the beginning of the study and 19.4% (n=304) ~~at the time of~~^{during} the final examination in 1994 [25]. ~~Half the population received annual brief tobacco interventions during the period 1992–1995 [24]. These interventions had no long-term effect on their smoking [26].~~

A questionnaire was sent to the available cohort (n=2,175) in 2008 to addresses obtained from the Population Register Centre (Figure 1). The response rate was

46.9% (n=1,020). Respondents were classified as smokers and non-smokers according to their responses to the question "Do you smoke?" (No/Yes). ~~Duration of smoking was calculated for ex-smokers by subtracting age at initiation from age at cessation. Duration of smoking was calculated for smokers by subtracting age at initiation from 29 (the average age of the cohort at the time of the questionnaire mailing). Amount of tobacco products consumed in numbers of cigarette was also elicited.~~

In the questionnaire the respondents were asked to look back at their smoking exposure in their schooldays. Our study was based on perceived influence theory and thus the respondent's own perception of his/her influences was of interest.

The respondents answering "yes" to the question "When you were of school age, did your father smoke?" (No/Yes/Can't say) were deemed to have had a smoking father in their schooldays. The same pattern was repeated with similar questions about the smoking habits of mother, brother, sister and ~~closebest~~ friend during respondents' schooldays. Those without a brother (or a sister) were treated as missing data according to the question on smoking behaviour of their brother (or sister). The respondents answering "yes" to the question "Does your ~~closebest~~ friend smoke?" were deemed to currently have a smoking best friend.

We also measured some potential confounders for smoking, ~~namely. These were~~ marital status, level of education and self-perceived health. Marital status was elicited ~~as (Single/Married/Cohabiting/Remarried/Divorced/Widowed).~~ Single, divorced and widowed respondents were classified as single, while in the analysis married, remarried and cohabiting respondents were classified as married or cohabiting ~~in the analysis~~. Education was classified as higher education if the

respondent had a polytechnic or university degree. All other education was classified as lower education. Respondents' self-perceived health was also elicited as (Very good/Good/Average/Poor/Very poor/Can't say). The responses were reclassified as Very good/Not very good, where all answers other than Very good were classified as Not very good.

In the envelopes there was also a cover letter describing the purpose and methodology of the study and a consent form were enclosed with the questionnaires. Only completed questionnaires returned with a signed consent form were used as data. The Ethics Committee of the Pirkanmaa Hospital District, Finland, approved the study protocol (R08017).

~~In this study we combined two different settings. The first setting was a prospective follow-up, where we used the information from the 1992 checkups and checked if these attitudes at the age of 13 had an association with smoking behavior in 2008. The second setting was retrospective and cross-sectional. In this setting we used only the information from the 2008 questionnaire and checked for associations with the respondents' own smoking behavior and that of their own best friends (current and in school) and family members.~~

Statistical analysis

~~We used IBM SPSS version 20.0 to conduct the statistical analyses. Binary logistic regression was used with 95% confidence interval (CI). To compare the mean age at smoking initiation and mean duration of smoking (Gaussian~~

distribution) we used the unpaired T test. Two binary outcome measures were compared with χ^2 test.

Analysis of non-response

We used the relevant measurements from the 1992 study to compare respondents to non-respondents (Table 1). Among respondents there were significantly more females and those who had not tried smoking by the age of 13. There were no differences between respondents and non-respondents according to smoking behaviour at the age of 13, willingness to try smoking (among those who were non-smokers at the age of 13) or smoking behaviour of parents.

Table 1: Comparison of the respondents and non-respondents to the 2008 follow-up according the baseline measurements from the 1992 questionnaire.

| | Respondents (n = 1020) | | Non-respondents (n = 1155) | | p-value |
|-----------------------------------|------------------------|------------|----------------------------|------------|---------|
| | n | % of group | n | % of group | |
| Smoking at age 13 | | | | | 0.097 |
| No | 972 | 95.3 | 1441 | 93.7 | |
| Yes | 48 | 4.7 | 97 | 6.3 | |
| Gender | | | | | <0.001 |
| Female | 605 | 59.3 | 646 | 41.9 | |
| Male | 415 | 40.7 | 895 | 58.1 | |
| Experimentations at age 13 | | | | | <0.001 |
| Had not tried smoking | 585 | 60.4 | 727 | 50.9 | |
| Had tried smoking | 383 | 39.6 | 702 | 49.1 | |
| Attitude at age 13 | | | | | 0.83 |
| Not willing to try smoking | 661 | 94.3 | 916 | 93.9 | |
| Willing to try smoking | 40 | 5.7 | 59 | 6.1 | |
| Parent smoking | | | | | 0.18 |
| No | 584 | 60.3 | 821 | 57.5 | |
| Yes | 384 | 39.7 | 606 | 42.5 | |

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Statistical analysis

We used IBM SPSS version 20.0 to conduct the statistical analyses. Binary logistic regression was used with 95% confidence interval (CI) and the depending variable was smoking (Yes/No) at the age of 29. Two binary outcome measures were compared with χ^2 -test. Missing data for a measurement was treated as non-response for that measure. Those who did not respond in the 2008 follow-up were treated as missing data for all measurements excluding those used for analysis of non-response (see below).

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RESULTS

Of all respondents 16.9% (n=168) were smokers in 2008 (Table 24). Smoking rates were 14.4% (n=86) among females and 20.4% (n=82) among males (p<0.05). The majority of respondents was married or cohabiting, had higher education and perceived their health to be very good (Table 24).

Table 24: Comparison of the cohort characteristics in the 1992 study and in the 2008 follow-up.

| 1992 initial study | | 2008 follow-up | |
|--------------------|------------|----------------|------------|
| (mean age 13) | | (mean age 29) | |
| n | % of group | n | % of group |

Gender

| | | | | |
|--------|-------|------|-----|------|
| Female | 1,251 | 48.8 | 596 | 59.8 |
|--------|-------|------|-----|------|

| | | | | |
|------|-------|------|-----|------|
| Male | 1,310 | 51.2 | 401 | 40.2 |
|------|-------|------|-----|------|

Smoking behavior

| | | | | |
|--------|-----|-----|-----|------|
| Smoker | 145 | 5.7 | 168 | 16.9 |
|--------|-----|-----|-----|------|

| | | | | |
|------------|-------|------|-----|------|
| Non-smoker | 2,413 | 94.3 | 829 | 83.1 |
|------------|-------|------|-----|------|

Marital**status**

| | | | | |
|--------|---|---|-----|------|
| Single | - | - | 221 | 34.5 |
|--------|---|---|-----|------|

| | | | | |
|--------------------------|---|---|-----|------|
| Married or cohabiting | - | - | 775 | 65.5 |
|--------------------------|---|---|-----|------|

Education

| | | | | |
|-------|---|---|-----|------|
| Lower | - | - | 338 | 34.2 |
|-------|---|---|-----|------|

| | | | | |
|--------|---|---|-----|------|
| Higher | - | - | 651 | 65.8 |
|--------|---|---|-----|------|

Self-perceived health

| | | | | |
|-----------|---|---|-----|------|
| Very good | - | - | 866 | 86.9 |
|-----------|---|---|-----|------|

| | | | | |
|---------------|---|---|-----|------|
| Not very good | - | - | 130 | 13.1 |
|---------------|---|---|-----|------|

The majority of smokers had lower education while only less than one third of non-smokers had lower education (Table 32). This difference was statistically significant. A statistically significant difference was found between smokers' and non-smokers' self-perceived state of health. One in ten non-smokers but one in four smokers reported their self-perceived health to be other than very good (Table 3). Smokers also differed statistically significantly from non-smokers with

regard to their self-perceived health; more than one out of four smokers had not very good self-perceived health while only one of ten non-smokers had other than very good self-perceived health (Table 2). There were also statistically significantly more females among non-smokers (Table 32). Only 18.5% (n=31) of the smokers had started to smoke at the age of 18 or older.

Table 32: Comparison of smokers and non-smokers according to the measured potential confounders.

| | Smokers (n = 168) | | Non-smokers (n = 829) | | p-value |
|-----------------------|-------------------|------------|-----------------------|------------|---------|
| | n | % of group | n | % of group | |
| Gender | | | | | 0.016 |
| Female | 86 | 51.2 | 510 | 61.5 | |
| Male | 82 | 48.8 | 319 | 38.5 | |
| Marital status | | | | | 0.155 |
| Single | 44 | 26.3 | 177 | 21.4 | |
| Married or cohabiting | 123 | 73.7 | 652 | 78.6 | |
| Education | | | | | <0.001 |
| Lower | 94 | 56.6 | 244 | 29.6 | |
| Higher | 72 | 43.4 | 579 | 70.4 | |
| Self-perceived health | | | | | <0.001 |
| Very good | 121 | 72.0 | 745 | 90.0 | |
| Not very good | 47 | 28.0 | 83 | 10.0 | |

Prospective setting

There were 24.1% (n=99) smokers in 2008 among those who reported having a smoking parent or smoking parents in the 1992 questionnaire, while only 11.7% (n=68) of those with the opposite response smoked ($p<0.001$). Females did not differ statistically significantly from males according to the results on this question: OR for being smoker was 2.0 (1.3–3.3) for females and 2.6 (1.5–4.7) for males with smoking parent(s).

Of those respondents who at the age of 12 reported intending to experiment with smoking, 27.5% (n=11) were smokers in adulthood, while only 12.3% (n=80) of those who did not intend to experiment with smoking, were smokers in adulthood ($p=0.01$). If the experiment had been conducted when the respondents were aged 12, the impact on adult smoking rate would have been even greater: one in four adolescents who had experimented with smoking were smokers at the age of 29 while there were only 9.2% smokers among those who had not experimented in adolescence ($p<0.001$). Parental acceptance of adolescent smoking or the assumption of continuing smoking did not have a statistically significant impact on smoking in adulthood.

Cross-sectional setting

There was a strong connection with the smoking behaviour of the current closebest friend. Among those males who currently had a smoking closebest

friend it was 7.1 (95% CI 3.6-14.0) times more likely that they, too, were smokers ~~(Table 3)~~. This connection was ~~even stronger among males, but~~ slightly weaker but still significant among females (OR 4.7, 95% CI 2.5-8.6). Among females ~~H~~ having a smoker as a close~~best~~ friend in school was connected with more than five times greater likelihood of being a smoker in adulthood ~~in females, but not in males~~ (OR 5.1, 95% CI 2.6-10.0). No connection with smoking behaviour of close friend in school was observed in males. Smoking of mother, brother or sister when the subject was of school age increased the likelihood of being a smoker more than twofold among males, but the smoking habit of any family member had no effect ~~not~~ among females. The smoking behavior of father when the subject was of school age did not have a connection with subject's smoking behavior in adulthood. ~~(Table 3)~~

Table 3: Comparison of females, males (univariate) and all respondents (adjusted by gender, marital status, education and self perceived health) according to their own smoking behavior and the smoking behavior of their family members and friends. OR = Odds Ratio, CI = Confidence Interval.

| | | Female | | Male | | All* | |
|-------------|-----------------|-------------|--------|-------------|---------|-------------|---------|
| | | p- | | | | | |
| | | OR (95% CI) | value | OR (95% CI) | p-value | OR (95% CI) | p-value |
| Best friend | In current life | | <0.001 | | <0.001 | | <0.001 |
| | Non-smoker | 1 | | 1 | | 1 | |
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|----------------------|------------|----------------|------------------|-----------------|-------------|-----------------|------------------|
| | Smoker | 4.7 (2.5-8.6) | | 7.1 (3.6-14.0) | | 5.0 (3.1-7.8) | |
| <i>In-school</i> | | | <0.001 | | 0.2 | | <0.001 |
| | Non-smoker | 1 | | 1 | | 1 | |
| | Smoker | 5.1 (2.6-10.0) | | 1.6 (0.8-3.1) | | 3.1 (1.9-5.0) | |
| Mother** | | | 0.45 | | 0.04 | | 0.06 |
| | Non-smoker | 1 | | 1 | | 1 | |
| | Smoker | 1.3 (0.7-2.5) | | 2.3 (1.1-4.9) | | 1.7 (1.0-2.8) | |
| Father** | | | 0.61 | | 0.9 | | 0.7 |
| | Non-smoker | 1 | | 1 | | 1 | |
| | Smoker | 1.2 (0.6-2.2) | | 1.1 (0.5-2.1) | | 1.1 (0.7-1.8) | |
| Brother** | | | 0.40 | | 0.04 | | 0.9 |
| | Non-smoker | 1 | | 1 | | 1 | |
| | Smoker | 1.4 (0.7-3.0) | | 2.1 (1.0-4.4) | | 1.6 (0.9-2.7) | |
| Sister** | | | 0.58 | | 0.04 | | 0.8 |
| | Non-smoker | 1 | | 1 | | 1 | |
| - | Smoker | 1.2 (0.6-2.6) | - | - 2.6 (1.1-6.2) | - | - 1.7 (0.9-3.0) | - |

Adjusted multivariate analysis

When the respondent was in school-age

In the adjusted model we combined all the family members and best friends (both current and in schooldays) with the measured confounders into a multivariate logistic regression (Table 4). ~~In this model self-perceived health and marital status had an independent connection with smoking behavior.~~ The impact of friends (current or in schooldays) persisted in the adjusted model while that of all the

family members disappeared ~~in the multivariate analysis~~ (Table 43). Self-perceived health and marital status had an independent connection with smoking behaviour in adulthood, but the strength of these connections was less than that of the influence of close friends.

Table 4: Logistic regression analysis of all respondents according to their own smoking behaviour and the smoking behaviour of their family members and friends with the potential confounding factors. All OR:s are multivariate including all tabulated variables. Depending variable was smoking at the age of 29. OR = Odds Ratio, CI = Confidence Interval.

| | | OR for being smoker (95% CI) | p-value |
|------------------------|------------|------------------------------|------------------|
| Close friend | | | |
| <i>In current life</i> | | | <0.001 |
| | Non-smoker | 1 | |
| | Smoker | 5.0 (3.1-7.8) | |
| <i>In school</i> | | | <0.001 |
| | Non-smoker | 1 | |
| | Smoker | 3.1 (1.9-5.0) | |
| Mother | | | 0.06 |
| | Non-smoker | 1 | |
| | Smoker | 1.7 (1.0-2.8) | |
| Father | | | 0.7 |
| | Non-smoker | 1 | |
| | Smoker | 1.1 (0.7-1.8) | |
| Sister | | | 0.8 |
| | Non-smoker | 1 | |
| | Smoker | 1.7 (0.9-3.0) | |
| Brother | | | 0.9 |
| | Non-smoker | 1 | |
| | Smoker | 1.6 (0.9-2.7) | |
| Gender | | | 0.14 |
| | Female | 1 | |

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|-------------------------------------|------------------------------|----------------------|---------------------|
| | <u>Male</u> | <u>1.4 (0.9-2.2)</u> | |
| <u>Marital status</u> | | | <u>0.012</u> |
| | <u>Married or cohabiting</u> | <u>1</u> | |
| | <u>Single</u> | <u>2.0 (1.2-3.3)</u> | |
| <u>Education</u> | | | <u>0.08</u> |
| | <u>Higher</u> | <u>1</u> | |
| | <u>Lower</u> | <u>1.5 (1.0-2.4)</u> | |
| <u>Self-perceived health</u> | | | <u>0.008</u> |
| | <u>Very good</u> | <u>1</u> | |
| | <u>Not very good</u> | <u>2.3 (1.2-4.1)</u> | |

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Differences were observed in the age of smoking initiation for the smokers and ex-smokers in the cohort. Smoking was initiated 0.8–1.7 years younger among those who had a smoking family member in their schooldays (Table 4). Initiation of smoking occurred almost three years earlier among those who had a smoking best friend at school and almost one year earlier among those currently having a smoker as a best friend. Mean duration of smoking was 1.2–2.5 years longer among those who had a smoker among their family members. The impact of best friend was even greater. Duration of smoking was 3.4 years longer among those whose best friend in school had been a smoker. Those whose current best friend was a smoker had 3.6 years longer duration of smoking. (Table 4)

Table 4: Mean differences in age at smoking initiation and duration of smoking of those smoker/ex-smoker subjects who had a smoking family member or best friend at school age and those who did not. P-values come from the unpaired T-test.

| | | |
|--|----------------------------------|-----------------------------------|
| | <u>Smoking initiation</u> | <u>Duration of smoking</u> |
|--|----------------------------------|-----------------------------------|

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|----|---------------------------------------|-----------------|------|-------------|--------------------|---------|---|------------------|--------------------|---------|
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| 4 | | | | | | | | | | |
| 5 | | | | | | | | | | |
| 6 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | - | - | - | Age (years) | Difference (years) | p-value | - | Duration (years) | Difference (years) | p-value |
| 9 | | | | | | | | | | |
| 10 | Best friend | | | | | | | | | |
| 11 | | In current life | | | 0.9 | <0.05 | | | 3.6 | <0.001 |
| 12 | | | | | | | | | | |
| 13 | | Non-smoker | 16.5 | | | | | 8.6 | | |
| 14 | | | | | | | | | | |
| 15 | | Smoker | 15.6 | | | | | 12.2 | | |
| 16 | | | | | | | | | | |
| 17 | | | | | | | | | | |
| 18 | | In school | | | 2.7 | <0.001 | | | 3.4 | <0.001 |
| 19 | | | | | | | | | | |
| 20 | | Non-smoker | 17.9 | | | | | 8.0 | | |
| 21 | | | | | | | | | | |
| 22 | | Smoker | 15.2 | | | | | 11.4 | | |
| 23 | | | | | | | | | | |
| 24 | | | | | | | | | | |
| 25 | Mother* | | | | 1.7 | <0.001 | | | 2.5 | <0.001 |
| 26 | | | | | | | | | | |
| 27 | | Non-smoker | 16.7 | | | | | 9.4 | | |
| 28 | | | | | | | | | | |
| 29 | | Smoker | 15.0 | | | | | 11.9 | | |
| 30 | | | | | | | | | | |
| 31 | Father* | | | | 0.8 | <0.05 | | | 1.2 | <0.05 |
| 32 | | | | | | | | | | |
| 33 | | Non-smoker | 16.5 | | | | | 9.7 | | |
| 34 | | | | | | | | | | |
| 35 | | Smoker | 15.7 | | | | | 10.9 | | |
| 36 | | | | | | | | | | |
| 37 | | | | | | | | | | |
| 38 | Other* | | | | 1.0 | <0.05 | | | 2.0 | <0.05 |
| 39 | | | | | | | | | | |
| 40 | | Non-smoker | 16.4 | | | | | 9.7 | | |
| 41 | | | | | | | | | | |
| 42 | | Smoker | 15.4 | | | | | 11.7 | | |
| 43 | | | | | | | | | | |
| 44 | Sister* | | | | 1.4 | <0.001 | | | 1.7 | <0.05 |
| 45 | | | | | | | | | | |
| 46 | | Non-smoker | 16.4 | | | | | 9.9 | | |
| 47 | | | | | | | | | | |
| 48 | - | Smoker | - | 15.0 | - | - | - | 11.6 | - | - |
| 49 | | | | | | | | | | |
| 50 | When the respondent was in school age | | | | | | | | | |
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In the share of smokers, the amount of tobacco products consumed did not differ according to the smoking behavior of current or school-age best friend. Neither did those whose brother or sister smoked consume more tobacco products. On the other hand, 64.7% (n=44) of those who had a smoking mother smoked more than 20 cigarettes per day while only 38.7% (n=36) of those whose mother did not smoke smoked as heavily ($p<0.05$). A similar difference was seen in the smoking behavior of father; there was an 18.5 percentage point greater share of heavy (more than 20 cigarettes per day) smokers among those with smoking father in their schooldays ($p<0.05$).

DISCUSSION

This study ascertained the gravity of the implications of having a smoking parent, sibling or friend. The greatest impact on adult smoking comes from the current ~~close~~^{best} friend. We see this as a result of orientation – we want a friend who reminds us of ourselves. We think that Ppeople who smoke see smoking as a part of their self-image and thus tend to make^{have} friends ~~with other~~^{who also are} smokers. ~~For many people smoking is an important field of social life and this also makes it a useful way of making friends. Friends who smoke increase the likelihood of their friends continuing smoking [27].~~

~~The response rate (46.9%) is satisfactory since we had no incentive or other external motivator to increase the enthusiasm to respond. An important strength of this study is that it combines two different methods: cross-sectional questionnaire in 2008 and the longitudinal follow-up from the 1992 questionnaire. Earlier~~

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studies have focused mainly on groups like families, siblings or friends in general. We studied the influences of all the immediate family members (mother, father, sister, brother) and ~~close~~^{best} friends both in schooldays and in adulthood, separately and from the same cohort. A recently published Finnish study concurs with our results about the importance of best friend's influence over family member influences [285]. This increases the reliability of our results. Unfortunately we did not have the prospectively measured information about the smoking behavior of the respondents' best friends. Our population is representative of Finns and our results can be generalised to comparable populations.

~~A weakness of our protocol is that the smoking behavior of parents, siblings and best friends was determined by only one question. Thus we do not know about the heaviness of their smoking, periods of abstinence and if their possible smoking was clearly visible to the subject. These are, however, unlikely to cause any bias in our results since we were interested in whether the subjects felt they had had smokers among their family or friends.~~

~~The impact of a smoking best friend at school seems different but equally significant: earlier onset of smoking and longer lasting smoking habit was observed among those who had a smoking best friend at school.~~ In an older American study it was concluded that male best friends have a greater influence on smoking initiation [198]. In our results males seemed to be less influenced by their best friends in school than were females. However, our interest was more in the persistence of smoking to adulthood and from this type of data ~~it is not possible to determine~~ the direction of causality cannot be determined. The gender

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6 differences could be explained by differences in social networking between males
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8 and females [269]. Girls tend to form intense bilateral friendships while boys'
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10 social networks are in large packs with ~~more~~ loose bonds of friendship. We still
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12 do not know who influences whom when it comes to transferring smoking
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14 behaviour from one friend to another.
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17 ~~Smoking behavior of males seems to be connected with the smoking behavior of~~
18 ~~family members. Among females the prospective analysis shows a connection~~
19 ~~with the smoking behavior of family members but the retrospective analysis does~~
20 ~~the opposite. Of all the family members studied the smoking behavior of mother~~
21 ~~had the greatest effect on the heaviness and persistence of the smoking habit. It~~
22 ~~seems that smokers who smoke due to family influences are different from those~~
23 ~~whose smoking initiation was influenced by friends. They consume more tobacco~~
24 ~~products and are thus likely to have a strong nicotine addiction [27].~~
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34 ~~Half of the cohort received up to four brief tobacco interventions while they were~~
35 ~~of school age. This is unlikely to cause any bias in our study since the intervention~~
36 ~~did not have an effect in long term follow up [28]. Recent evidence of cessation~~
37 ~~interventions is in line with our findings [29].~~
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43 ~~Twin studies have shown that the heavier the smoking is in adolescence, the more~~
44 ~~likely it is to continue in adulthood [30]. We did not measure the heaviness of~~
45 ~~smoking in adolescence but in our results the smoking behavior of parents was~~
46 ~~associated with the subjects' heaviness of smoking in adulthood. This emphasizes~~
47 ~~the importance of family influences. Our results can be generalized to~~
48 ~~industrialized populations.~~
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~~Innumerable~~There are a vast number of studies ~~have~~ consider~~ed~~ing methods of smoking cessation involving medical consultations. We want to emphasiz~~e~~ that smoking prevention must not be seen as something only doctors can do. The onset of a lifelong smoking habit is usually in adolescence [3034]. One can also say that if ~~a person does~~you do not start to smoke in adolescence, ~~that person is unlikely~~it is likely that you will not ~~to~~ start to smoke at all. The culture of emulation among growing adolescents, routine cessation program~~mes~~ for expectant parents, tobacco price policies, tobacco advertisement restrictions and impeding access to tobacco products are something we really need to take seriously if we want to quell the smoking epidemic. Only a very small part of this work can be done in the doctor's consultation ~~room~~, but it is important that the work that doctors do with their patients is consonant with the consistent anti-smoking strategies. The results of this study demonstrate the great importance of close friends' influence. This should be noted as an advantage for planning anti-smoking actions addressing social influences.

~~Limitations~~IMITATIONS

The response rate (46.9%) ~~was~~is low but satisfactory since we had no incentive or other external motivator to increase the ~~inclination~~enthusiasm to respond. We concede that selection bias had an effect on our results: in 1992 almost one of two respondents were female but in the 2008 follow-up three of five respondents were female. The smoking rates among our study population were lower than those reported by population studies in Finland [22] and this is likely to be caused by response bias. Most respondents had higher education and very good self-

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perceived health. Thus it is likely that many of those with health problems and lower education did not respond to the 2008 follow-up. This affects our results: it is likely that there were more adult smokers among the non-respondents.

We did not ~~elicit~~measure parental occupation, parental income or parental education. Thus, these potential confounders may have affected~~could affect~~ our results. We did not measure the smoking behaviour of the respondents' schooldays ~~close~~best friends prospectively and thus it is possible that the ~~close~~best friend was recalled ~~incorrectly~~falsely.

A weakness of our protocol is that the smoking behaviour of parents, siblings and ~~close~~best friends was determined by only one question. Thus we do not know about the heaviness of their smoking, periods of abstinence and if their possible smoking was clearly visible to the subject. These are, however, unlikely to have caused any bias in our results since we were interested in whether the subjects felt they had had smokers among their family or friends.

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CONCLUSIONS

The smoking behaviour of a ~~close~~best friend is significantly associated with subjects' own smoking behaviour in adulthood. The impact of this association is much greater than the impact of smoking family members. This should be taken into consideration in attempts to prevent smoking initiation or continuation.

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COMPETING INTERESTS

None declared.

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Medical School, University of Tampere, Finland.

CONTRIBUTIONS

AJS designed the study, gathered and processed the data and wrote the paper, JK
designed the study and wrote the paper, KJM supervised, designed the study,
processed the data and wrote the paper. All authors contributed to and have
approved the final manuscript

DATA SHARING STATEMENT

Extra data is available by e-mailing AJS.

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WHAT THIS PAPER ADDS?

The smoking influence of all family members and ~~close~~^{best} friends both ~~during when in~~ school age and in adulthood ~~were have been~~ studied ~~in from~~ the same population in order to compare the strength of the influences. This makes it possible to compare the effects of genetic and epigenetic influences on smoking in adulthood.

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FIGURE LEGEND

Figure 1: Flow-chart of the evolution of the cohort.

For peer review only